

IMPROVEMENT OF SPECIMENS FINAL INSPECTION PROCESSES IN REGIONAL GROUP OF SME

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Abstract – The example of proficiency improvement process is presented here. The main idea of that process is support for a group of enterprises. Appropriate activities allow achieving a good practice in parameter determination. The first step is to consider general rules in order to avoid any disagreement during whole process passing. Here useful are recommendations given in “new approach” of quality systems, according to the normative documents ISO. Therefore the team has a possibility to prepare, verify and finally validate their final inspection procedures. Training sessions help to implement proper test methods. A correlation between different test stands and applied procedures could be also found out in this way. Previously the most important influences, which could occur there, should be given an attention. It allows achieving and maintaining appropriate quality conditions there. Moreover it provides the criteria for competence qualification. Subsequently the responsible management has a possibility to determine personnel proficiency. It is a reason for joining both proficiency improving and credibility assuring processes regarding to different test stands. R&D unit, as the independent body, could acknowledge results obtained there.

Keywords – SME. Final inspection tests. Proficiency. Credibility. Process control.

1. INTRODUCTION

The achievement of creditable results, acquired during specimens quality diagnostics, is the important factor of marked competition and progress for each Small and Medium Enterprise (SME). Then it is essential to prepare, establish and finally to introduce to the continuous use the adequate procedure of quality (full or statistical) inspection.

Very often several sector-orientated SME are the clients for one R&D organisation, which is competent in products research – for parameters indication or normative conformance acknowledgement. Therefore a working team should carry out appropriate scope of tests. The R&D unit fulfils itself to carry over its experience to the regional and sector orientated SME.

To achieve that goal they should organise a team (R&D unit, as the server + group SME, as the client). The responsible supervisor should have the certain authority for managing of any appropriate activities (see fig.1.).

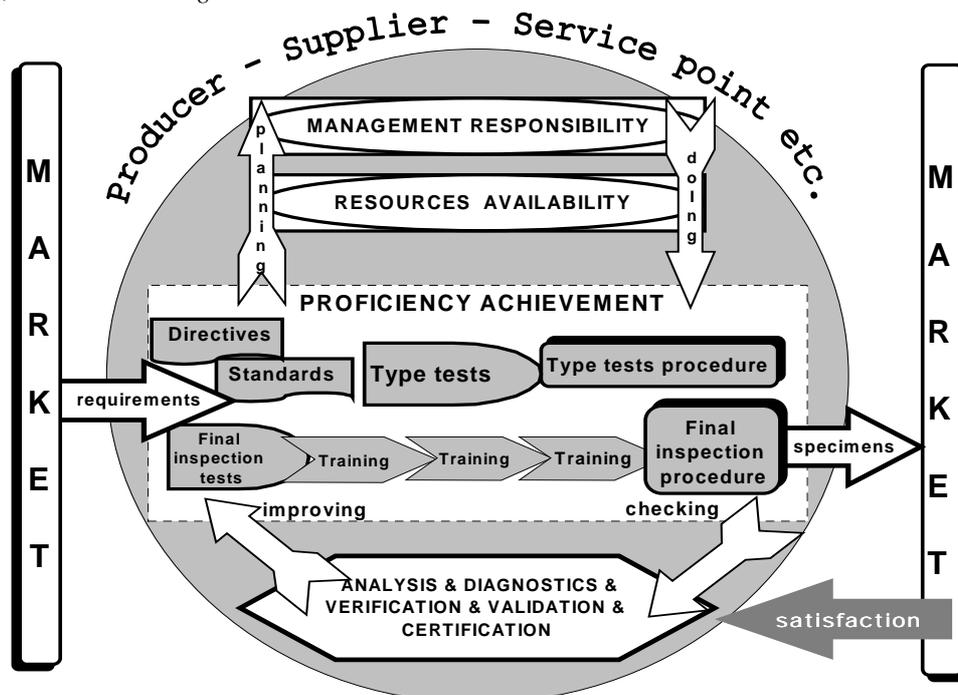


Fig. 1 - Model of proficiency improvement process

The organiser should be able to solve quality problems by research and develop any new test methods, which are to be applied there. He shall be also independent in evaluation and assessment scope. Undoubtedly any industrial R&D units have the experience in adequate test methods usage. They generally fulfil above-mentioned conditions, because government has established them, also they are not connected with any big company. Obviously, it is easier to achieve a solution of any problems by organising appropriate activities, controlling and supervising all works by the same, competent and independent body. Very often inside there the testing laboratory exists, which has been accredited in appropriate scope. The status of this laboratory allows that kind joint venture with SME's, because that laboratory is not a competitor in market for them.

Adequately, the organiser shall protect so that any kind of benchmarking or promotion would not be put out from the results got out in this process. A group should consider the general rules, specified for quality systems. Here they could implement any normative recommendations from international standards of process control in quality management. For any producers and purchasers ISO-TC176 has proposed a new process orientated approach, as the standard ISO 9001:2000 [1]. Suitably, for testing laboratories presently ISO orders the standard ISO/IEC 17025 [2].

We can notice implementation of both these models (and either theirs similar previous versions) of quality assurance system at the one R&D organisation. It also takes place in authors affiliated institute.

2. THE GOAL AND FORMS OF ACTIVITY

A lot of producers from sector orientated SME have the same or similar problems in quality assurance scope. They could identify, show or analyse some problems successfully, if they were using a synergy of wide group. The representative assessment of acquired results requires to engage at least several participants and to use a proper number of specimens under test.

The laboratory should prepare the type test procedure and then: verify, implement and finally achieve the approval of the undertaken procedures. Test methods and appropriate procedures ought to be documented and implemented - conformably to proper quality regulations. The laboratory is interested in receiving the proper certificate, regarding to stand and procedure of the specific type tests. It is a result of independent assessment carried out by the appropriate accreditation body.

As the final effect of these activities are the credible and traceable tests stand in R&D laboratory, reference data (results of type tests) and appropriate knowledge. For all of the group members, the main idea is to assure compatibility and dependability regarding to approved type test method. Conformity verification touches up instrumentation equipment, software, personnel experience, also concerns any medial and environmental features in a technological

stand. However acceptable are any differences between those both procedures, as followed:

Type tests procedure in testing laboratory:

- ✓ Mandatory environmental conditions keeping out.
- ✓ Traceability to high-level measure standards carried out before each test.
- ✓ Reproducibility and repeatability achievement and continuous maintenance.

Final inspection procedure in producer's stand:

- ✓ Normal environmental conditions (wider scope of permissible changes), proper for industry – monitored.
- ✓ Periodically checking traceability by result compare.
- ✓ Only repeatability assurance.

That common working group could simultaneously improve those both procedures by any interaction between them, joined with test results comparison. These aspects, as well as an integration of both “new approach” quality systems - for SME certification and for laboratory accreditation - give that opportunity. The main goal is to assure high level of credibility for results of final inspection. Participants should also fulfil any specific and additional requirements, or at least consider these. There are for instance: measurement ability, repeatability, reproducibility – assurance of whose, or ways for theirs achievement. These features could be determined as quality parameters of each test stand. It would be good to determine those parameters by one simple function, depending on the stand structure, environmental conditions and the testing time.

Fig. 2 shows example of knowledge and experiences transfer from R&D unit to the group of SME. It is similar to comparison method, applied in order to validate the specific test method [3]. The head of laboratory ought to be the supervisor where, at all steps of that process. Flow diagram shows the sequence of activities, which are to be performed by different participants ($n=1,2, \dots, N$).

The supervisor fulfils his duties for that process control. There are methods, resources and procedures verification and finally theirs validation. He could apply appropriate forms or modify that process passing. In the beginning, he uses any simple means for decreasing the probability of putting out results, which could most differ to each other and to the throw value. Then he analyses all influencing factors in order to assess their importance for test results credibility. Most significant ought to be stabilised in thin span, otherwise these at least shall be monitored. The supervisor waits for conformance to any mandatory rules, as well as to requirements, which have been between participants agreed. Finally, supervisor determines quality features of each test stand. There are different indicators as well as a correlation factors regarding to all SME test stands, in reference to the laboratory stand.

As the test objects, different specimens could be used. If these were programmable devices, for instance transducers, then it would be a possibility to check easily or freely arrange theirs characteristics.

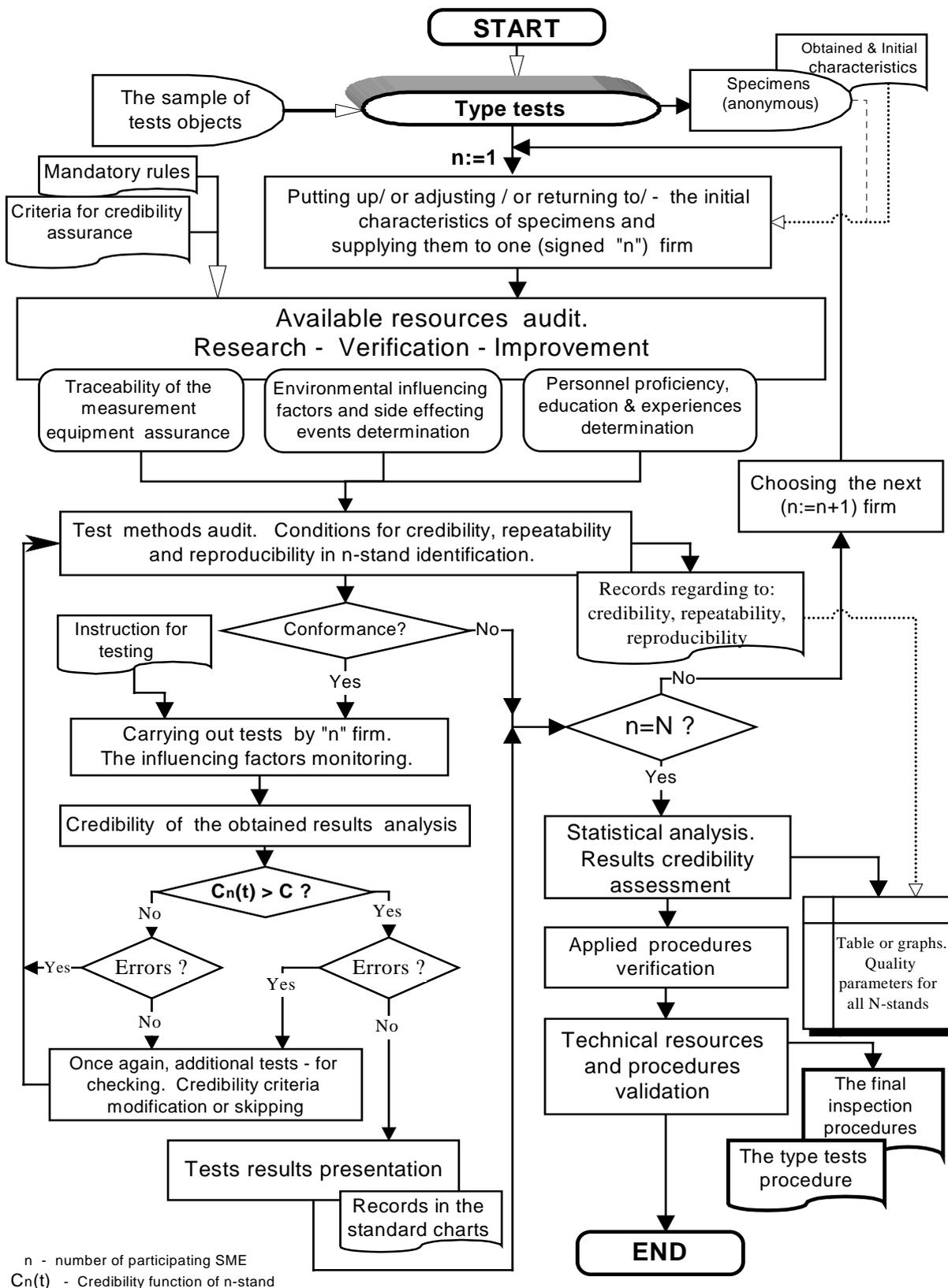


Fig. 2. The example of process control for testing proficiency improvement

3. TRAINING AND PROFICIENCY ASSESSING

In order to minimise any human and instrument errors during specimen inspection, the common working group should agree and organise any training sessions at measurements and testing techniques. Obviously, SME personnel, by immediately working with the laboratory workers, increase his proficiency.

The organiser, also effects assessor and whole process supervisor, should:

- assure deal of proper number of participants and proper quantity of test sample,
- keep confession during all theirs works, as well as regarding to tests results,
- indicate (or returning to) appropriate characteristics for tests sample, basing in type tests results,
- prepare tests sample of specimens and proper charts for assure the unified form of any results recording,
- verify and qualify needed resources (stands, equipment, media, environment) meaning in appropriately to test procedures - at least theirs dependability, accuracy and traceability,
- introduce the tests instruction, which perform formularies for results recording,
- collect all tests results followed by computing them for the statistical assessing,
- prepare the final test report with scheduling all results, non expected accidents, failures or any noticed difficulties etc.
- determine the credibility features and correlative factors based in statistical assessment.

The test sample consists of constant number the same objects, but between them could exist several “bad” specimens. These “bad pieces” could be programmed so that theirs characteristics exceed a “Maximum Permissible Error” – only for a proficiency performance. During process (fig. 2) passing, these pieces should be noticed property. Regarding to intentionally “good” or “bad” pieces there are four possible cases, which could be described by values of conditional probability, as it shows fig. 3. These values may be determined by statistical processing.

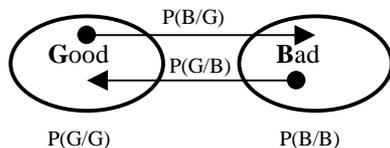


Fig. 3. Illustration of probabilities determination

Producers very often are making the final inspection stand as a terminate part of the technological line. Environmental influencing factors, especially atmospheric and supply parameters are different there. In industry these are more sever and more changeable as in laboratory. Precision of results getting there depends of many factors, as deterministic, as random, very often difficulty identifiable.

Our “PIAP-LAB” laboratory has researched these influencing factors in several different factories. The random

events, which were to be detected, earlier have been experimentally determined – regarding to IEC standards for appropriate resistance tests. Monitoring carried there has showed a correlation between these prior defined events and tests results, acquired there. Parameters, as rapid temperature changes, vibrations and EM disturbances have had a stochastic character with a big dispersion of distribution. It concerns any events, which have been classified as influencing factors for automatic measurements systems, assembled in technological lines.

Generally, the small enterprises have not methodical tools and instrumentation for detecting these events and for assessing their influence to the results obtained there. For simple solving any credibility problems, they could use the proper measure standards, but these are often not accessible for them. Laboratory standards, which have been traced in reference to higher level standards and are dependably maintained there, could help SME in that scope.

Adequate possibility gives a comparison the current results to the reference results. That concerns the reference results, which have been:

- acquired from the type tests made “a priori”,
- acquired from the type tests made “a posteriori”,
- obtained from any other special tests for this purpose.

Any result comparison method is easier and cheaper for SME, especially for repeatability assessment. Obviously these results ought to be verified and validated in reference to traceable measurements standards.

For assessing proficiency as well as for obtained results comparison could be applied different methods of transferring the tests sample [3], as followed:

Type A1). The test sample directly circulates from one participant to another, through all their stands.

Type A2). The test sample after being used in n-stand comes back to the supervisor, where he checks it with returning to primary characteristics (if it is needed). Following that, the test sample should be transferred to next (n+1) participant.

Type B. Random choosing the n test samples from unified production, which have the same objects numerous, in order to pass them on to all participants simultaneously. All objects have earlier determined parameters.

Type C. As in type B, but without determining parameters before tests.

For many events, a good idea is to apply the type A2; because then the supervisor can observe any partial results and can modify the process during covering them.

4. REPEATABILITY AND REPRODUCIBILITY

We can notice a correlation of repeatability or reproducibility to results credibility, regarding to the specific tests stand. That touches up the work conditions and other dependable resources. There perform any similarly as well as any different credibility problems regarding to both kinds of tests: type tests and final inspection tests.

In order to results credibility determination, the type test performer should look at several different characteristics of

specimen, which are to be determined by generating any expected determinants of disturbances or stresses. These ought to be prior defined and subsequently determined by simulation during type tests. They could have the same significance as any values of uncertainty of instruments.

In industry, any environmental conditions very often vary there and are not the same as in laboratory. Respectively to the characteristics, which have been determined during the type tests, or taken from appropriate environmental parameters classification [4] - the supervisor should establish any dependable criteria. These criteria serve to keep out significant influencing and side-effecting parameters $\langle X_i \rangle$ in required range, or at least to monitor them during each tests stand. For instance the probability $P(X_i)$ of exceeding the border level or range b_i , could be set as a criterion. So that should fulfil the condition: $P(X_i > b_i) < \text{constant (i)}$. It is a reason for observing them during whole test process. Testing manager should detect such phenomena as accidents of the limit transgression, any power distortion occurrence, human errors etc. The type tests in laboratory obviously demand to set those limits more sever as it is answering for test stands in industry.

Approximately, these each other independent accidents can be qualified as random stationary and ergodic Poisson's process, described at formula:

$$P_k(t) = [(\lambda t)^k / k!] e^{-\lambda t} \quad (1)$$

λ - is the mean value of intensity of those k failure accidents in period 't';

$k = 0, 1, \dots, n$ - is the number of those failure accidents in period 't'.

According to (1) the probability of satisfy that criterion can be simply determined as:

$$q(t) > e^{-\lambda t} \quad (2)$$

Relatively, the probability of faulty results getting out in the time 't' is:

$$p(t) < (1 - e^{-\lambda t}) \quad (3)$$

The activities showed in fig. 2 give a possibility to determine the digital value - for example $q(t) > 0,95$. It is needed for validation any results, obtained there.

The good idea is, if the supervisor gives for each SME stand (n-stand) the proper recommendations in order to its credibility maintenance for a long time. These recommendations, he could previously determine as the credibility function. That function {let it call as $C_n(t)$ } individually determines n-stand. Fully developed form of that function is:

$$C_n(t) = f \{ [U_n], q_n(t) \} \quad (4)$$

$C_n(t)$ depends of testing time and of random values:

- whole uncertainty of n-test stand (for any measurement equipment existing there) - the set $[U_n]$,
- the probability of absence any influencing events- $q_n(t)$.

That $C_n(t)$ function shows the difference between results obtained during final inspection in n-stand, in comparison to the reference results. Obviously, if $q_n(t)$ is closely 'one', then $C_n(t)$ shows the proper credibility, but not the same as in the laboratory (more sever) condition.

The supervisor can determine the range of $C_n(t)$ values, when results of the final inspection could be not creditable. It is useful only, if any influences occurred in each tests stand have been earlier statistically determined or at least currently monitored there.

Repeatability determines $C_n(t)$ function only. Reproducibility achieving is more difficult, because it is determined by both $C_n(t)$ and $C_m(t)$ functions consideration (previously n-stand and current m-stand) also depends on possible difference in time of tests carrying out.

5. SUMMARY

Only principal aspects of that kind of proficiency improvement methods, which are to be applied in SME, have been presented here. The overall validation of specimens final inspection procedure, which is many times used in testing operation, consist of:

- assessment of assurance the general, object oriented (normative) requirements for these tests,
- identification the most important influence factors, witch could perform during the final inspection process,
- implementation the prior determined credibility function, depending on influencing factors - for each tests stand.

The base for the above presented process is the conformance with dependable (for producers responsibility) and normative (EN standards) requirements, as well as to the specific client's wishes. The last duty is important regarding to producers from SME. The main effects of that process are:

- verified and validated the type test procedure in laboratory, which can be the reference for other tests,
- correlated to that reference the final inspection procedure, which is to be used in SME,
- credibility of the declared specimen parameters, which could be also acknowledged by independent body.

REFERENCES

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 - Section 3: Stationary use at weatherprotected location